A New and Annectant Type of Chilopod.

By

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With Plate 23.

INTRODUCTION.

The continent of Australia and its adjacent islands have hitherto proved singularly disappointing in the production of interesting types of Chilopoda. Setting aside Cermatobius, which was discovered some fifteen years back in the island of Adenara, none of the genera known up to the present time from the Australian region throw special light upon the phylogeny of the families of this class; none can be regarded as archaic forms that have found refuge in this southern tract of land. Collections made in various districts of the country have yielded specimens of Scutigera, Henicops, Lithobius, Scolopendra, Cryptops, Geophilus—genera which may be met with on a single hillside in almost any part of Southern Europe; of Cormocephalus and Ethmostigmus, which in an almost equal degree are characteristic of tropical Africa or the Oriental region. The entire fauna, in short, bears the stamp of comparatively recent origin by immigration from South Eastern Asia, with perhaps an infusion from the Ethiopian region or Madagascar.

In 1892, however, I received from Mr. G. M. Thomson, of Dunedin, New Zealand, a small consignment of Myriapods from the summit of Mount Rumney, Hobart, Tasmania, which completely falsified the opinion that the Antipodes hold nothing peculiar or primitive in the way of centipede-life and are wholly given over to the occupation of widely distributed and well-known forms. The collection in question contained a couple of centipedes representing a species which proves to be comparable in interest from a morphological standpoint to either of its compatriots, Ceratodus or Ornithorhynchus, inasmuch as it unmistakably represents an archaic type, which has survived in this isolated corner of the world—a type which possesses the two-fold interest of exhibiting certain unique structural peculiarities of its own, coupled with others that serve to link together three of the best-known and most diversified sections of the class; and also of showing the true, but previously unknown and unsuspected, nature of the connection between the metamerism of the Scolopendromorpha and that of the Lithobiomorpha.

This new centipede is the subject-matter of the following essay. The account of it may be conveniently divided into four headings:—(1) A description of the external structural features of the animal; (2) a comparison between it and the other existing orders; (3) its significance in testifying to the transformation of the Scolopendroid into the Lithobioid type; (4) the classification of the Chilopoda.

Part I.—Description of the Genus and Species.

Fam. Craterostigmidæ.

Gen.—Craterostigmus, nov.

The cephalite or head shield (Pl. 23, figs. 1, 3, 8) is longer than wide, leaving the toxicognaths largely uncovered on the dorsal side, as in some genera of Geophilomorpha (i.e. Mecistocephalus); its frontal sulcus is distinct, and its præantennal area sharply recurved to form a long subfrontal area, as in other pleurostigmous Chilopods. The eyes are represented by a single pair of ocelli, as in the Lithobiomorphous genera Henicops and Cermatobius. The antennæ are basally approximated, and project forwards from the fore margin of the cephalite, and consist of about the same number of segments as is found in the primitive Scolopendromorpha. The labral sclerites are distinct, and the labral border is deeply and subquadrately excised in the middle, the sides of the excision being membranous and furnished with bristles, while its anterior border is armed with five teeth (Pl. 23, fig. 9).

Gnathites.—The first pair, or mandibles, are furnished beneath (posteriorly) with a thick fringe of hair, and above (anteriorly) with a large membranous lobe beset with short hairs; between this lobe and the hairy fringe appear nine pectiniform, horny teeth, arranged in slightly overlapping series of three each (Pl. 23, figs. 10—12). The second pair or maxillæ much resemble those of, e.g. Scolopendra, the basal segment (coxa or stipes) having its proximal margin widely rounded, the first segment of the ectocorm (= first malar segment of the external maxilla of Latzel) short, and the second segment (= second malar segment) a little longer than broad and evenly convex along the margin; the entocorm (= internal maxilla) consists of a single short segment. The basal segments of the right and left sides meet in a much longer sutural union than is seen in Scolopendra (Pl. 23, fig. 13).

The palpognaths (= labial palpi, second pair of maxillæ, or first pair of maxillipedes) are also much like those of Scolopendra, but the ectocoxite (= outer segment of the stipes of Latzel) is more strongly produced posteriorly. As in the genus just mentioned, the distal segment is swollen and thickly fringed on its upper (anterior) margin, but the claw is almost concealed in hairs, both from its anterior and posterior aspects (Pl. 23, figs. 14, 14*a*).

The toxicognaths (second pair of maxillipedes, poison-jaws or prehensors) present a combination of characters recalling those of Scolopendra in the presence of dentate præcoxal and præaxial femoral processes; those of Mecistocephalus and some other species of Geophilomorpha in the large-size and subquadrate shape of the coxal plate, the length of the femora, and the extent to which the terminal segment or fang overlaps the cephalite anteriorly; those of the Lithobiomorpha in the completeness of the penultimate and antepenultimate segments (patella and tibia), which postaxially intervene between the distal extremity of the femur and the proximal extremity of the fang (tarsus) (Pl. 23, figs. 1—3).

The pleural sclerites of the toxicognaths extend as far forwards as the anterior border of the tergum of the toxicognathic somite, but fall far short of the proximal end of the femora (Pl. 23, figs. 1, 3, *pl.*).

The tergum of the toxicognaths (= basal plate) resembles that of some Geophilomorpha (e.g. Mecistocephalus) in size; it is as wide as the cephalite, which it underlies in front, but much narrower than the tergum of the first pediferous somite, which it overlaps behind (Pl. 23, figs. 1, 3, *bp.*).

The pediferous somites differ from those of all Chilopoda hitherto known, in that the tergal plates are numerically in excess of the sternal, the latter being fifteen in number, as in the Lithobiomorpha, and the former twenty-one, as in most Scolopendromorpha.

The terga are unequal in size, but not alternately larger and smaller; the first is very large, and considerably overlaps the second, the fourth overlaps the third in front and the fifth behind, the seventh overlaps the sixth in front and the eighth behind, the ninth meets the tenth without distinct overlap, the twelfth overlaps the eleventh in front and the thirteenth behind, the fifteenth overlaps the fourteenth in front and the sixteenth behind, the remainder normally overlapping the anterior border of those that succeed them, the overlapped area being smooth and defined by a transverse groove; the tergum of the last somite is completely coalesced with the chitinised pleural area.

The pleural súrfaces of all the pediferous somites, except the thirteenth, fourteenth, and fifteenth, are furnished with a distinct præcoxal sclerite (= epimeron of Latzel); the stigmatiferous somites are furnished in addition with a usually smaller, stigmatic sclerite in front and a larger metastigmatic sclerite behind, both beneath the edge of the tergum; a sclerite representing the stigmatic in position is also found below the edge of the third, sixth, ninth, eleventh, fourteenth, and seventeenth terga; and a sclerite corresponding to the metastigmatic is present below the first, second, fifth, eighth, tenth, thirteenth, and sixteenth terga; but below the third, sixth, ninth, eleventh, fourteenth, and seventeenth terga it is less developed, being either small and narrow, or represented by a weakly chitinised integumental ridge. Towards the posterior end of the body the præcoxal sclerite increases in size, and encroaches upon the pleural membrane, until on the last three somites the pleural area is covered with a continuous chitinous plate, which is fused with the sternum, and, in the case of the last somite, with the tergum also, as already stated (Pl. 23, figs. 3—7).

The sterna are subequal and laterally emarginate for the articulation of the legs; a pair of transversely elongated præsternal sclerites extend in front of their anterior border, as in the Scolopendromorpha; on the last two somites these sclerites fuse with the sterna (Pl. 23, figs. 3, 4, 6).

The stigmata, subcircular or suboval in shape, are six in number on each side, and lie above the third, fifth, eighth, tenth, twelfth, and fourteenth pairs of legs, as in the genus Lithobius, and beneath the fourth, seventh, twelfth, fifteenth, eighteenth, and twentieth terga. With the exception of those on the penultimate somite, which lie far back, the stigmata are situated more forwards than in other Chilopoda, being slightly in front of the articulation of the legs, and of the middle of the lateral margin of the terga (Pl. 23, figs. 3, 4, 15).

The legs are fifteen in number on each side, as in the Lithobiomorpha; with the exception of the last pair they consist of what is doubtless the primitive number of segments in the Chilopoda, namely six, the distal segment being undivided, as in the Geophilomorpha and the less specialised genera of Scolopendromorpha and Lithobiomorpha; the basal segments are relatively larger than in the Scolopendromorpha, but smaller than in the Lithobiomorpha, and they show no progressive increase in size towards the posterior end of the body, such as is characteristic of the members of the latter order (Pl. 23, figs. 16, 17). The legs of the fifteenth pair differ in certain particulars from those of all Chilopods. The basal segments or coxæ are of medium size, freely articulated to the posterior end of the last somite, without encroaching in any way upon its pleural area, and like the trochanters of the two preceding pairs are armed below with a long spike. The second segments or trochanters, on the other hand, are reduced in size and completely fused with the proximal end of the femora, as in the Scolopendromorpha. In the members of the latter order, however, as well as in the Geophilomorpha, the coxal segment is indistinguishably united to the enlarged præcoxal pleural sclerite. Again in the Lithobiomorpha and Scutigeromorpha, which resemble Craterostigmus in the freedom of the coxa, this segment occupies the whole of the pleural area of the somite, and the trochanter remains distinct. As in all Chilopoda, with the exception of some Geophilomorpha, the tarsus of the fifteenth leg is bisegmented (Pl. 23, figs. 18, 19).

Projecting between the legs of the last pair is a sclerite, formed by two valves united in the median dorsal line and meeting ventrally, when closed, in a long slit representing the combined genito-anal aperture. This bivalvular sclerite is probably the homologue of the dorsal plate of the anal somite, which in some genera of Chilopoda, e. g. Scolopendra and the male of Lithobius, is of larger size than that of the genital somite, and partially or wholly supersedes it. No trace of skeletal plates of the genital somite or of gonopods is visible externally. The latter in all probability have atrophied from enclosure within the genito-anal cavity, embraced by the above-described sclerite (Pl. 23, figs. 5—7, *ag.*).

Craterostigmus tasmanianus, sp. n.

Measurements in mm.—Total length from anterior border of cephalite to posterior border of twenty-first tergite 37, width across coxal plate of toxicognaths 3·8; length of cephalite 3·4, width 2·2; length of antenna 9·5, of posterior leg 12; length of last tergite 2·4, width 2.

Colour yellowish brown, with the cephalite and toxicognaths darker reddish brown. Integument sparsely hairy and punctured.

Cephalite parallel-sided, its posterior border convexly rounded; frontal area with its sides converging between the eyes and the base of the antennæ.

Eyes some distance behind the antennæ; frontal sulcus projecting posteriorly between the eyes, with strongly convex backward curvature.

Antennæ about one fourth the length of the body and head, rather less than three times as long as the head; the segments hirsute, especially towards the distal end of the appendage, subcylindrical, longer than wide, the first segment strongly constricted in its basal half.

Præcoxal processes of toxicognaths long, armed apically and externally with seven teeth. Inner side of femur and femoral process armed with about five teeth, the proximal of which lies far back just in front of the suture marking the line of union of the trochanter and the femur.

Basal plate with posterior angles rounded.

Terga without longitudinal grooves, with posterior border straight, posterior angles rounded and unthickened margins; the last tergum, and to a lesser degree the last but one, granular; the last with a weak longitudinal lateral crest in its anterior half, its posterior border sinuous, its middle third slightly and convexly produced.

Sterna without grooves, those of the posterior somites granular, the granules, as in the case of those on the terga, formed by the elevations round the setiferous pores; sterna area of last marked anteriorly on each side with an oblique, shallow groove.

Legs shortish, hairy, armed with a single inferior tibial and tarsal spine. Claw with two basal spinules, one inferior and one posterior. Posterior legs long and slender, about one third the length of the body and head, longer than the antennæ, without spines, protarsal and tarsal segments subequal, segments subcylindrical, tarsal and protarsal subequal; femur, patella and tibia progressively decreasing in length. Trochanter of the thirteenth and fourteenth armed below with a horny spike, which is shortest on that of the thirteenth coxa of fifteenth similarly armed.

The genito-anal sclerite is about half the length of the last leg-bearing somite. When viewed from the dorsal or ventral aspect its sides are seen to be convex, and to converge posteriorly to a point. From the lateral aspect its upper edge, which is compressed, is straight and horizontal; its inferior edge convex, the two meeting at an acute angle of about 45°.

PART II.—SUMMARY OF THE CHIEF CHARACTERISTICS OF CRATEROSTIGMUS, AND A COMPARISON BETWEEN THIS GENUS AND OTHER CHILOPODA.

The structural peculiarities of this new Chilopod and the complex nature of its relationship to the other existing types of this class, which are only imperfectly manifested in the above-given description, may be more fully emphasised and revealed in a clearer light by a brief summary: firstly, of the characters in which it particularly resembles each of the three most nearly allied groups; secondly, of those that it shares with two of them to the exclusion of the third; and lastly, of those in which it differs from all. Adopting the terminology I have elsewhere proposed, I shall speak of these groups as the Lithobiomorpha, Scolopendromorpha, and Geophilomorpha, leaving the explanation of the use of these names and the rank assigned to them to be dealt with in a later part of this essay.

With the fourth group, Scutigeromorpha, no comparison of Craterostigmus will be necessary, since the only morphological points the two have in common, apart from those shared by all Chilopods, are those mentioned in the statement of the resemblances between Craterostigmus and the Lithobiomorpha.

One or two of the features of Craterostigmus, namely, the armature of the posterior legs, the structure of the mandibles, etc., have been omitted from the list detailing the peculiarities of this genus, as of doubtful taxonomic value, although the structure of the mandible is likely enough to prove of high importance in this particular.

1. Characters in which Craterostigmus resembles the Lithobiomorpha and differs from the Scolopendromorpha and Geophilomorpha.—The completeness of the penultimate and antepenultimate segments of the toxicognaths, so that the femoral segment and fang are separated from each other on the outer (post-axial) side of the appendage; the presence of fifteen sternal plates and of fifteen pairs of locomotor appendages, with relatively large basal segments; the distinctness of the coxa of the fifteenth pair of legs; the presence of six pairs of stigmata on the somites represented by the third, fifth, eighth, tenth, twelfth, and fourteenth pairs of legs; the presence of a single monomeniscous eye on each side of the head, as in the genera Henicops and Cermatobius.

2. Characters in which Craterostigmus resembles the Scolopendromorpha and differs from the Lithobiomorpha and Geophilomorpha.—The co-existence of large dentate præcoxal and femoral processes on the toxicognaths, as in Scolopendra, Otostigmus, etc. The presence of twenty-one tergal plates. The presence of a large and distinct metastigmatic pleural sclerite, and the increase in size of the præcoxal sclerites towards the posterior end of the body. The fusion of the trochanter (second segment) of the legs of the fifteenth pair with the femur.

3. Characters in which Craterostigmus resembles all or some Geophilomorpha, e. g. Mecistocephalus, and

differs from the Scolopendromorpha and Lithobiomorpha.—The large size of the toxicognaths and the extent to which they overlap the cephalite anteriorly and laterally; the presence of a distinct, subquadrate, basal plate, which is much narrower than the tergum of the first leg-bearing somite and intervenes between it and the cephalite; the entirety of the distal segment of the penultimate pair of legs.

4. Characters in which Craterostigmus resembles the Scolopendromorpha and Geophilomorpha and differs from the Lithobiomorpha.—The enlargement of the tergum of the first leg-bearing somite; the size and completeness of the fusion of the two halves of the coxal plate of the toxicognaths; the relative equality in size between the coxæ of the legs; the presence of the præsternal sclerites upon the ventral area of the somites.

5. Characters in which Craterostigmus resembles some or all of the Lithobiomorpha and Scolopendromorpha and differs from all the Geophilomorpha.—The number of antennal segments exceeding fourteen; the presence of eyes; the inequality in size of the terga; the terga, sterna, and pairs of legs falling short of thirty-one; the reduction in the number of stigmata, which fall short of half the number of somites; the spine armature of the legs.

6. Characters in which Craterostigmus resembles the Lithobiomorpha and Geophilomorpha and differs from the Scolopendromorpha.—The presence of a distinct "basal plate" separating the cephalite from the tergum of the somite bearing the first pair of legs; the inability to withdraw the anal and genital somites within the somite bearing the legs of the last pair.

7. Characters in which Craterostigmus differs from all other known Chilopoda.—The fact that the pleural sclerite of the toxicognath covers only the posterior portion of the upper surface of the coxal plate on each side, and falls far short of the proximal end of the femur; the numerical excess of the terga over the sterna, the pairs of legs and the

stigmata; the fusion of the sternal and pleural sclerites of the penultimate and antepenultimate somites, and the complete coalescence of the tergal, pleural, sternal, and præsternal elements of the last somite to form a compactly chitinised subcylindrical tube; the distinctness of the coxa of the posterior leg, coupled with its articulation to the posterior extremity of the somite and the fusion of the trochanter with the femur; the representation of the external skeletal elements of the genital and anal somites by a pair of valves fused dorsally, but opening ventrally by a long slit-like aperture, whence the genital and anal products escape to the exterior.

The above-given comparisons demonstrate the impossibility of associating Craterostigmus with either of the groups of Chilopoda hitherto recognised, and substantiate its claim to take a rank at least as high as that which is assigned to the others individually, call them families, sub-orders, orders,—what you will.

PART III.—THE TESTIMONY SUPPLIED BY CRATEROSTIGMUS AS TO THE DESCENT OF THE LITHOBIOMORPHA FROM THE SCOLOPENDROMORPHA.

Apart from the characteristics peculiar to itself, which present us with new facts in Chilopod morphology; apart, too, from those that it shares with either one or more of the previously known divisions of this class of Arthropods, the chief point of interest vested in Craterostigmus lies in the explanation it furnishes of the principal resemblances and differences obtaining between the Lithobiomorphous and Scolopendromorphous types of structure, and also in the new and wholly unexpected light it throws upon the metamerism of these two types, enabling us to picture the process by which the one has been converted into the other.

Except for the numerical difference, the somites of Lithobius and Scolopendra exhibit certain obvious and well-known resemblances with regard to the distribution of the stigmata, and the alternate development of larger and smaller tergal plates.

In both forms the first, third, fifth, seventh, eighth, tenth, twelfth, and fourteenth terga are large, the second, fourth, sixth, ninth, eleventh, thirteenth, and fifteenth small, and stigmata are situated beneath the lateral margins of the third, fifth, eighth, tenth, twelfth, and fourteenth. On the other hand, the difference consists in the circumstance that whereas in Lithobius the genital and anal somites succeed the fifteenth, in Scolopendra no fewer than six somites —repeating the characters of those that precede them, the sixteenth, eighteenth, and twentieth being large and stigmatiferous, the seventeenth, nineteenth, and twenty-first small and astigmous—are intercalated between the fifteenth and the genital.

These facts forcibly suggest the conclusion that the fifteen somites of Lithobius are homologous to the anterior fifteen somites of Scolopendra, and that the reduction in the number of somites in the former is due to the excalation of six somites between the fifteenth and the genital, or to the failure to develop them from the embryonic "caudal lobe," the genital somite being presumably homologous in the two forms, and, in conjunction with the anal somite, representing in the adult the posterior portion of the "caudal lobe" in the embryo.

There is an attractive simplicity about this view of the case which formerly induced me to hold it as a working hypothesis. But the discovery of Craterostigmus puts a quite different complexion on the whole question.

In the first place, the correspondence with respect to numbers of stigmata and legs between Craterostigmus and Lithobius, and the position of the stigmata above the bases of the third, fifth, eighth, tenth, twelfth, and fourteenth legs on each side, fully justifies the supposition that the stigmata and legs are strictly homologous in the two forms. Indeed, it is not easy to see what other opinion on this point is to be held. But the stigmata in Craterostigmus lie beneath the fourth, seventh, twelfth, fifteenth, eighteenth, and twentieth tergal plates; whence it follows that these tergal plates are the dorsal elements of the somites bearing the third, fifth, eighth, tenth, twelfth, and fourteenth pairs of legs. That is to say, Craterostigmus, as compared with Lithobius, has one extra tergal plate without sternal or appendicular representative between the first and third pediferous somites, one between the third and fifth, two between the fifth and eighth, one between the eighth and tenth, and one between the tenth and twelfth, making in all a total of six. Which are these supernumerary terga? the second or the third? the fifth or the sixth? which two of the eighth, ninth, tenth, and eleventh? the thirteenth or fourteenth? the sixteenth or seventeenth?

The answers to these questions are not at first sight easily given, owing to the difficulty of deciding which of two terga overlying a sternum is its representative on the dorsal area. Careful examination, however, of the nature of the folds and the development of sclerites in the pleural integument shows that the terga without sternal complements are the third, sixth, ninth, eleventh, fourteenth, and seventeenth, these being the plates beneath which the representatives of the metastigmatic pleural sclerite is scarcely or not at all developed. Moreover the third, sixth, eleventh, and fourteenth terga are overlapped posteriorly by the terga that lie behind them; the ninth does not overlap the anterior border of the tenth; and the seventeenth, although overlapping the eighteenth in the normal manner, does not overlie the præcoxal sclerite of the eleventh pediferous somite, but is, as it were, wedged in between the tergum of this and of the following somite.

In the second place, the similarity between Craterostigmus and Scolopendra in the structure of the maxillæ, palpognaths, and toxicognaths, in the number of antennal segments, the equality in size of the coxæ, the fusion of the trochanter of the posterior legs with the femur, the presence of præsternal sclerites, etc., renders unavoidable the conclusion that the twenty-one terga in the two forms are homologous plate for plate. Assuming that this is so, and that the opinion given above touching the supernumerary terga is also correct, it follows that the passage from the Scolopendroid type, with twenty-one complete somites, to the Lithobioid type, with fifteen complete somites, was effected by the excalation of the third, sixth, ninth, eleventh, fourteenth, and seventeenth somites of the former type. This new explanation of the connection between the metamerism of the two types is illustrated in the annexed diagrams (p. 433), and may be tabulated as follows :

Scolopendroid Type.	Lithobioid Type.
1 major and astigmous represents	1 major and astigmous or stigmatiferous.
2 minor and astigmous represents	2 minor and astigmous.
3 major and stigmatiferous.	Excalated.
4 minor and astigmous represents	3 major and stigmatiferous.
5 major and stigmatiferous represents	4 minor and astigmous.
6 minor and astigmous.	Excalated.
7 major and astigmous or stigmatiferous represents	5 major and stigmatiferous.
8 major and stigmatiferous represents	6 minor and astigmous.
9 minor and astigmous.	Excalated.
10 major and stigmatiferous	7 major and astigmous.
11 minor and astigmous.	Excalated.
12 major and stigmatiferous represents	8 major and stigmatiferous.
13 minor and astigmous represents	9 minor and astigmous.
14 major and stigmatiferous	Excalated.
15 minor and astigmous represents	10 major and stigmatiferous.
16 major and stigmatiferous represents	11 minor and astigmous.
17 minor and astigmous.	Excalated.
18 major and stigmatiferous represents	12 major and stigmatiferous.
19 minor and astigmous represents	13 minor and astigmous.
20 major and stigmatiferous represents	14 major and stigmatiferous.
21 minor and astigmous represents	15 minor and astigmous.
22 genital represents	16 genital.
23 anal represents	17 anal.

If the theory here set forth be in accord with fact, it is evident that the similarity, exact though it be, between the fifteen leg-bearing somites of Lithobius and the anterior fifteen leg-bearing somites of Scolopendra, with respect to the alternation in size of tergal plates and the number and disposition of stigmata, is the outcome of homoplasy and not of homology.

Startling as this proposition may at first seem, the difficulties in the way of its comprehension are not insuperable.

Accepting the comparison between the somites of the two, as tabulated above, and assuming, as is justifiable, that the stigmata occurring upon the first, third, and tenth somites of the Lithobioid type and unrepresented on the corresponding somites of the Scolopendroid type have not been independently acquired in the former case, we are forced to conclude that the Scolopendroid type itself has been derived from a form possessing stigmata at least upon the first, third, fourth, fifth, seventh, eighth, tenth, twelfth, fourteenth, fifteenth, sixteenth, eighteenth, and twentieth somites, since stigmata are found upon these somites either in the Scolopendroid type or upon their hypothetical equivalents in the Lithobioid.

It is possible, however, to go a step further. Since all the Geophilomorpha, without exception, and one, in this respect, aberrant genus of Scolopendromorpha, namely Plutonium, possess stigmata upon all the leg-bearing metameres except the first and last, it is no strain upon probability to assume that the primitive Scolopendromorph was furnished with stigmata upon all the leg-bearing somites except the last. Furthermore, since stigmata are found only upon major somites, it follows that all the somites were originally of that kind. This contention is fortified by the consideration that similarity in size and structure of the individual segments of a series is one of the first laws of metamerism.

Hence, although it may be impossible to give a physiological explanation of the fact, no difficulty on morphological grounds obstructs the acceptance of the opinion that a typical Scolopendroid, like Rhysida, with stigmata only upon the third, fifth, seventh, eighth, tenth, twelfth, fourteenth, six-

EXPLANATION OF FIGURE OPPOSITE.

Diagram to illustrate the homology of the metameres in Chilopoda of the Scolopendroid, Craterostigmoid, Lithobioid, and Scutigeroid types.

LETTERING AND NUMBERING FOR ALL FIGURES.

at. Antenna. *c.* Cephalite. *b.* Basal plate = tergum of somite-bearing toxicognath. *t.* Toxicognath. *p.* Palpognath. 1—21, 1—15, 1—8. Terga of leg-bearing somites. 1′—21′, 1′—15′. Sterna of leg-bearing somites. *g.* Genital somite. *a.* Anal somite.

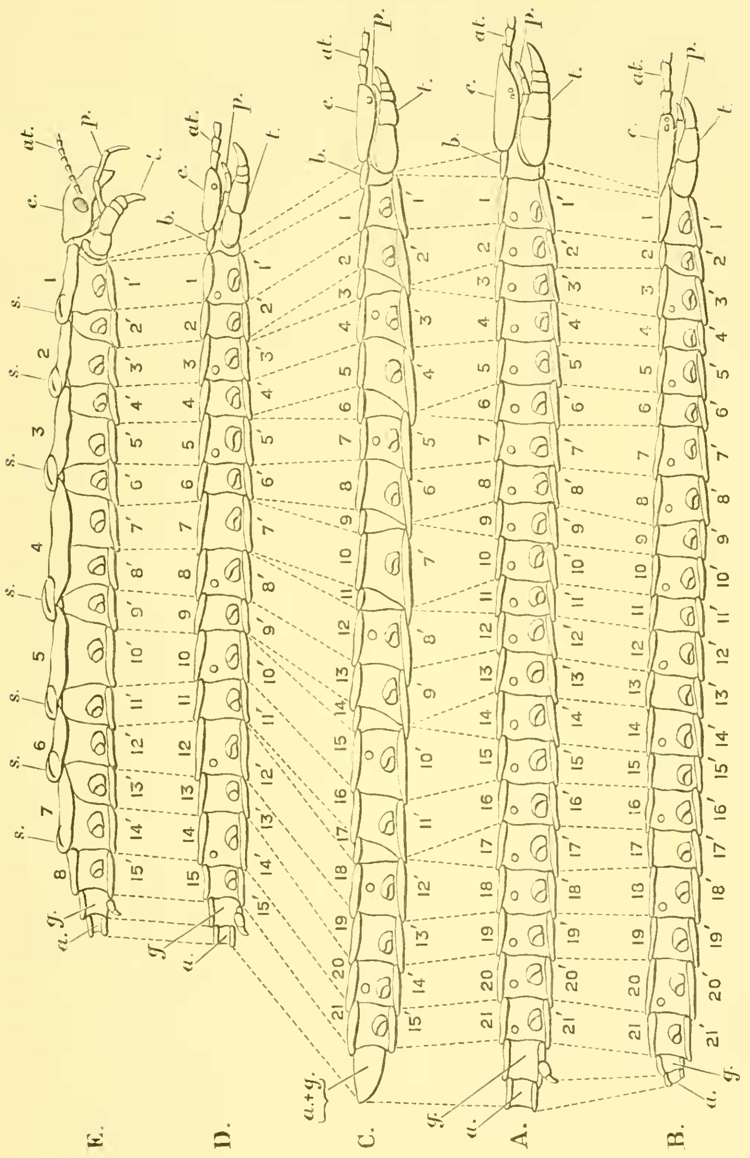
A. Hypothetical primitive Scolopendroid with twenty-one subequal stigmatiferous somites, with gonopods on the genital somite (*g.*), a distinct tergal plate (*b*) on the somite bearing the toxicognaths, and with the penultimate and antepenultimate segments complete on the post-axial side of this appendage.

B. Typical Scolopendroid, resembling Rhysida, derivable from A by the restriction of the stigmata to the somites numbered 3, 5, 7, 8, 10, 12, 14, 16, 18, 20; by the incipient differentiation of the leg-bearing somites into major stigmatiferous and minor astigmous; by the suppression of the gonopods; and by the obliteration of the tergum of the toxicognath and of the penultimate and antepenultimate segments of this appendage on its post-axial side. This figure also shows the juxtaposition of the two major somites numbered 7 and 8.

C. Diagram of Craterostigmus to show its derivation from A by the restriction of the stigmata to the somites numbered on the dorsal side 4, 7, 12, 15, 18, 20, and by the excalation of the sternal area and appendages of the somites numbered 3, 6, 9, 11, 14, 17; also by the coalescence of the elements of the genital and anal somites to form a bivalvular capsule ($a+g$).

D. Typical Lithobioid, resembling Henicops, derivable from C by the completion of the excalation of the half-somites in C numbered on the dorsal side 3, 6, 9, 11, 14, and 17, but retaining the distinctness of the genital and anal somites and the stigmata upon the first leg-bearing somite, as in A. This figure also shows the alternation of major stigmatiferous and minor astigmous somites, the juxtaposition of the two major somites, 7 and 8, and the change of the major somites from the odd to the even numbers in the posterior half of the body.

E. Diagram of Scutigera to show its descent from a Lithobioid of the Henicops type (D) by the dorsal migration and fusion of the stigmata; by the enlargement of the stigma-bearing tergal plates, their backward extension over, and almost complete obliteration of, the terga of the minor somites represented ventrally by the sterna numbered 2′, 4′, 6′, 9′, 11′, 13′, and by the fusion of the terga of the seventh and eighth somites to form a single plate (4)—the two processes resulting in the presence of eight visible tergal plates instead of fifteen. This figure also shows the widely separated antennæ, the polymeniscous eye, the large projecting præantennal area of the cephalite, the long and pediform palpognath and partially rotated toxicognath, characters in which Scutigera differs from all known Chilopods.


E.
D.
C.
A.
B.
at.
p.
c.
t.
b.
s.
a.
g.
a.+g.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
1' 2' 3' 4' 5' 6' 7' 8' 9' 10' 11' 12' 13' 14' 15' 16' 17' 18' 19' 20' 21'

teenth, eighteenth, and twentieth somites, and Craterostigmus with these organs restricted to the somites represented by the fourth, seventh, twelfth, fifteenth, eighteenth, and twentieth tergal plates, have descended along divergent lines of evolution from a primitive Scolopendromorph with stigmata upon all the leg-bearing somites except the last.[1] But since the fourth, seventh, twelfth, fifteenth, eighteenth, and twentieth tergal plates in Craterostigmus represent the dorsal elements of the third, fifth, eighth, tenth, twelfth, and fourteenth somites of a Lithobiomorph, the similarity between the latter and a typical Scolopendroid, with respect to the location of stigmata, may be regarded as merely coincidental without any infringement of probability.

So, too, with regard to the resemblance in alternation of larger and smaller somites. This alternation is no doubt beneficial in the way of favouring flexibility and rapidity of torsion. Its acquirement, therefore, may be regarded as advantageous. But this does not explain why there should be an exact correspondence in this particular, if the two forms under consideration have been independently evolved from a type in which all the somites were major. Why, it may be asked, are the second, fourth, sixth, ninth, eleventh, thirteenth, and fifteenth somites minor in their constitution in both cases, and the others major? The explanation is to be found in the situation of the stigmata. The invariable absence of stigmata from minor somites in the Chilopoda justifies the view that the presence of these apertures and of the tracheal trunks that arise from them is incompatible with somites of that nature. This is supported by what occurs in the Geophilomorpha, where a large number of breathing orifices appears necessary for respiration underground, and where all the somites are major and subequal. But functional representatives of the minor somites of the Scolopendroid

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[1] The atrophy of the breathing orifice upon the first leg-bearing somite in the Geophilomorpha, the Scolopendromorpha, and Craterostigmus is no doubt traceable to the modification impressed upon this somite by the great development of the muscularity of the toxicognaths.

and Lithobioid types have been acquired by a secondary segmentation of the metameres which has given rise to the intercalation of a series of small segments between the genuine somites. Unless in the case of these centipedes there were some factor inimical to the presence of stigmata, and the trunks arising therefrom, upon minor somites, it is difficult to explain why the somites do not alternate in size, when the necessity for the alternation is attested by the secondary development of the sub-segments above referred to, and when the capacity for the segmentation of fresh somites from the embryonic caudal lobe seems practically limitless.

Postulating, then, the expediency of alternation in size of somites, and the incompatibility of the presence of stigmata upon those belonging to the minor category; seeing too that the third, fifth, eighth, tenth, twelfth, and fourteenth, both in the Lithobioid and the Scolopendroid types, have retained their stigmata and their major nature; and that the first, although astigmous in the Scolopendroid and often in the Lithobioid, is also major, it is no matter for surprise that the second, fourth, sixth, ninth, eleventh, thirteenth, and fifteenth are minor in both cases.

But again, it may be asked, why does the regular alternation of major and minor somites cease with the somite which in the two types is numerically the seventh from the anterior end—an arrangement which results in the change of the major somites from the odd to the even number, the major being odd and the minor even in front of the seventh, while the converse holds behind it?

As for the change itself, we must remember that it is a law of Chilopod metamerism that the number of leg-bearing metameres is invariably odd. Hence, since the first leg-bearing metamere belongs always to the major and the last always to the minor category, both being odd-numbered, the regular alternate succession of major and minor metameres is an impossibility so long as the law is adhered to. At one point at least in the series an alteration in the order of sequence must be introduced, which will result in two major or two minor somites coming together. And surely we should expect the alteration to be effected, as indeed it is, by the juxtaposition of two major instead of two minor metameres if, as has been suggested, all the somites belonged originally to the major category.

That the change sets in in Lithobius close to the middle of the body, and in Scolopendra in the anterior third, may perhaps be explained by some such consideration as the following. The juxtaposition of two major somites is no doubt unfavourable to free flexibility; and since it is advantageous for the greatest possible freedom of movement to lie in the anterior and posterior ends of the body, which bear the principal external organs set apart for the performance of the vegetative and generative functions, the reason becomes clear for the juxtaposition of two major somites to take place as near as can be to the middle of the body in Lithobius, where the body is relatively short, few-jointed, and less flexible. In Scolopendra, on the other hand, with its longer, more jointed, and therefore more flexible body, it is probably immaterial where the juxtaposition of the major somites exactly occurs, provided it is sufficiently distant from both ends not to interfere with the full flexibility of the head and tail.

There appears, then, to be no insuperable or even serious difficulties in the way of believing that the similarity in segmentation between the Lithobiidæ and typical members of the Scolopendridæ is assignable to homoplasy. If, on the other hand, it is attributable to the direct homology of the somites concerned, the view that Craterostigmus exhibits a stage of segmentation intermediate between those of the other two must be wrong. In that case no genetic significance can be attached to the presence of twenty-one tergal plates in Craterostigmus and in Scolopendra. The numerical likeness must be regarded as purely coincidental. This view of the matter I find it impossible to adopt when the other many and deep-seated structural details in which the two forms approximate to one another are taken into consideration.

Finally, it may be stated with confidence and without fear of contradiction that the true nature of the connection, as above explained, between the metamerism of the Lithobioid and Scolopendroid types would never have been guessed, had it not been for the fortunate survival of this intermediate form with the six additional somites of the last-named type in process of excalation.[1]

PART IV.—CHARACTER AND CLASSIFICATION OF THE CHILOPODA.

It is beyond the scope of this article to give a detailed account of the development of the various classifications of the Chilopoda that have been proposed. The main outlines of the subject need only be sketched. Concerning the division of the class into the four main sections typified by Geophilus, Scolopendra, Lithobius, and Scutigera, there has been a pretty general consentience; but authorities have been divided into two schools of opinion touching the relationship of these sections to one another. The first, maintaining the isolation of the Scutigeridæ, was set on foot by Latreille in 1825 ('Faune du Règne Anim.,' p. 327), was supported by Brandt ('Bull. Acad. St. Petersb.,' vii, p. 311, 1840), and held its own practically unchallenged until the publication of Newport's last monograph in 1856, when Brandt's classification of the class into Schizotarsia for

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[1] It is perhaps necessary to point out that the line of argument here adopted to explain the descent of the Lithobioid from the Scolopendroid type is based upon the conviction that intercalation of somites never occurs. Were this otherwise the process of transformation might be reversed, and the Scolopendroid type derived from the Lithobioid; but this would in no sense invalidate the contention that Craterostigmus occupies an intermediate position between the other two. Haase ('Zeits. ent. Breslau,' pt. viii, 1881, pp. 93—115) held an entirely different view in dealing with the phylogeny of the Chilopoda. He regarded the richer metamerism of the Geophilidæ and Scolopendridæ as a derived, and not as a primitive character. Both Geophilidæ and Scolopendridæ have descended, according to him, from a primitive "epimorphous" stock, which was itself derived from an earlier "anamorphous" type, whence, along independent lines of development, arose the Lithobiidæ and Scutigeridæ.

Scutigera, and Holotarsia for the Lithobiidæ, Scolopendridæ, and Geophilidæ, appeared modified only in minor particulars. The second, uniting Scutigera with Lithobius, to the exclusion of the other two, was founded by Meinert in 1868 ('Nat. Tidskr.,' p. 246), who arranged the groups of Chilopoda as follows :—Geophili, Scolopendræ, and Lithobii, the last including the two tribes Lithobiini and Scutigerini.

Although this system was rejected in 1880 by Latzel ('Die Myr. Österr.-Ungar. Mon. I'), who allowed the four families instituted by Leach and Newport to stand unassociated, it was taken up and amplified by Haase, who, adopting the four families and Meinert's view of the near relationship between Scutigera and Lithobius, went a step further and classified the Chilopoda into the Anamorpha and Epimorpha, the first containing the Scutigeridæ and Lithobiidæ, the second the Scolopendridæ and Geophilidæ ('Schles. Chilopoda,' Breslau, 1880, Inaug.-Dissert.).

This classification of Haase's was adopted unchanged by Meinert ('Trans. Amer. Phil. Soc.,' xxiii, p. 163, 1886), and with certain amplifications by Bollman ('Bull. U.S. Nat. Mus.,' xlvi, p. 163, 1893) and Silvestri ('Ann. Mus.,' Genova (2), xiv, pp. 622—634, 1895).

The variation proposed by Bollman consisted in the subdivision of the "order" Anamorpha into two sub-orders, for the first of which, containing the Scutigeridæ, he used Brandt's term Schizotarsia; while for the second, including the Lithobiidæ and Cermatobiidæ, he introduced the new term "Unguipalpi," in allusion to the presence of a claw upon the palpognaths.

Silvestri followed Bollman in splitting the Anamorpha, and replaced the Schizotarsia and Unguipalpi with the new names Anartiostigmata and Artiostigmata, to which an ordinal value was attached. He further divided the Epimorpha into two orders, namely, Oligostigmata for the Scolopendridæ, and Pantastigmata for the Geophilidæ.

Although Haase's classification has the unquestionable merit of drawing attention to the undeniable relationship subsisting between the Scutigeridæ and the Lithobiidæ on the one hand, and the Scolopendridæ and Geophilidæ on the other, it appears to me to be open to the serious objection of obscuring the value of the great structural differences which separate the Scutigeridæ not only from the Lithobiidæ, but from the Scolopendridæ and Geophilidæ as well, and of ignoring the many and important features in which the Lithobiidæ resemble the Scolopendridæ.[1]

The characters which justify the association of the Lithobiidæ with the Scutigeridæ are the following:—the presence of fifteen pairs of legs in the adult, of seven pairs in the newly hatched young, the rest being added with successive moults; the presence of stigmata upon the same somites; the completeness of the penultimate and antepenultimate segments of the toxicognaths; the absence of all trace of "sub-segments" on the somites; the large size of the coxæ of the legs, and the freedom of those of the posterior pairs, and the presence of powerful gonopods in the female—characters which are not found in the other families.

But although these similarities attest the derivation of the Scutigeridæ from Chilopoda of the Lithobioid type, there can surely be no two opinions as to the extent to which they are outweighed when placed in the balance against the many and deep-seated characteristics in which Scutigera differs from all other existing centipedes.

My views on this point were expressed in the classification proposed in 1896 ('Biol. Centr. Amer.,' Chilopoda)—a classification which, allowing for the alteration in terminology and an elevation in rank of the groups, was that of Latreille, Brandt, and Newport amplified.

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[1] No doubt Haase found confirmation for his views in the discovery of the genus Cermatobius—a genus differing from all the Lithobiidæ known to him, and approaching the Scutigeridæ in its longer, "funiculate" antennæ, longer and subdivided tarsi, absence of coxal pores, longer female gonopods, and slightly more dorsal stigmata. There is no doubt, however, that Cermatobius is very closely related to Lamyctes and its allies. For example, although typically four or five in number in these forms, the coxal pores are reduced to one on each coxa in Haasiella and in Henicops, as typified by maculatus, the anterior tarsi consist of three segments, and the posterior pairs of six—facts which largely discount the value of the absence of coxal pores and the rich tarsal segmentation in Cermatobius.

Two sub-classes were recognised, the Artiostigma for the order Scutigeromorpha, and the Anartiostigma for the Lithobiomorpha, Scolopendromorpha, and Geophilomorpha.

If, as I venture to think, this system expressed at the time more accurately than Haase's the importance of the characters of Scutigera and the relationship between the Lithobiidæ and the Scolopendridæ, the opinion that it embodies receives the strongest support from the discovery of Craterostigmus. In no sense does this genus tend to lessen the structural interval between the Scutigeroid and Lithobioid types; but it largely depreciates the value of the characters the two have in common—the characters, in short, upon which Meinert and Haase relied when uniting them. Those who in the future maintain the Anamorpha must base this group upon the completeness of the penultimate and antepenultimate segments of the toxicognaths and the numbers of stigmata and pairs of legs, if Craterostigmus be included; for this genus negatives the remaining characters of the group, with exception of the number of legs at hatching, a point about which few would venture to hazard a guess so far as Craterostigmus is concerned.

In connection with the classification here submitted, it is desirable to justify the changes in terminology that have been introduced. Notostigma and Pleurostigma are preferred to Artiostigma and Anartiostigma because the latter were used in a much more restricted sense by Silvestri; and to Schizotarsia and Holotarsia because these two lost their applicability with the discovery of Cermatobius. Ungnipalpi connotes a character which holds only when the Lithobiidæ are associated with the Scutigeridæ; and Pantastigmata and Oligostigmata make no allowance for the pantastigmous character of Plutonium, which nevertheless is closely related to the oligostigmous forms.

Class Chilopoda.

Opisthogoneate tracheate Arthropods descended from a primitive type in which the body consisted of a large number of metameres similar in size and form, each with a broad tergal and sternal plate, connected by a pleural membrane, a pair of stigmata, and a pair of short hexarthrous, mononychous appendages. At an early phylogenetic stage the stigmata disappeared from the last three somites in connection with the special functions these somites were set apart to fulfil, the last or anal losing its appendages and being degraded to the condition of a carrier of the anal orifice; the penultimate or genital being, like the anal, reduced in size as a safeguard against damage, but retaining its appendages in a dwarfed form as manipulators of the ova or spermatophores; and the antepenultimate or last leg-bearing somite having its appendages enlarged and directed backwards to protect the genital somite, and, in later stages, to become modified as tactile, offensive, or secondary sexual organs. Anteriorly two pairs of appendages, retaining a primitive biramous structure, were set apart as gnathites; and a single pair, lying in front of the latter, consisting of not fewer than fourteen homonomous segments, and widely separated at the base, as antennæ. The dorsal area of the three somites represented by the appendages just mentioned was covered by a single plate, the cephalite or head shield, which was furnished laterally with eyes, and was curved downwards in front over the mouth to form a labrum or upper lip. For seizing and holding prey, the six-jointed appendages of the two metameres behind the head were turned forwards towards the mouth, their basal segments becoming enlarged and encroaching upon the sternal area, each appendage at the same time undergoing a partial axial rotation, so as to fold in a horizontal rather than a vertical plane. The first pair of these appendages retained its primitive pediform structure, while in virtue of the development of a poison gland, accompanied by an increase in the thickness of its segments, practically the sole function of prehension was taken over by those of the second pair.

Sub-class Pleurostigma.

Chilopods resembling the primitive type in the possession of a system of tracheal tubes, the orifices of which open upon the pleural area of more or fewer of the somites; and in the presence of a distinct tergum and sternum on each leg-bearing somite, the number of sterna never exceeding that of the terga. Eyes are either preserved or lost; when preserved they are monomeniscous, and variable in number on each side from one to about forty. Correlated with the relative simplicity in the structure of the metameres just mentioned is a marked specialisation of the head and the appendages connected therewith, a specialisation which was initiated apparently by the retroversion of the præantennal area of the cephalite resulting in the projection of the antennæ from the fore-margin of the head thus formed, and in the backward movement of the mouth with the gnathites of the first and second pairs into more intimate connection with the palpognaths and toxicognaths. As concomitants of this process the last-named appendages shortened and thickened, were axially rotated so as to move and fold in a horizontal plane, one segment of the palpognaths was suppressed, and the basal segments of the toxicognaths became firmly fused and incapable of independent movement; and lastly, the gnathites of the second pair being underlain by the two pairs that succeed them, failed to develop or lost the sense-organ which is found in the other sub-class.

Order 1.—Geophilomorpha.

Chilopods retaining a large and indefinite number of metameres in response to the demands of a subterranean existence requiring serpentine powers of movement. To further subserve this end, most of the somites are either partially or completely divided into two anteriorly, a process which, when perfected, gives rise to a series of sub-segments alternating with the true somites, the former being represented by a prætergal and a pair of præsternal plates. Stigmata are retained on all the somites, except the first and last, for purposes of respiration under ground; and the legs, which are short and play but a subsidiary part in locomotion, preserve the primitive number of segments, the basal of which remains small.

The eyes, as useless organs, have disappeared; and the antennæ are relatively short and consist invariably of fourteen segments. The gnathites are specialised and variable in structure; the penultimate and antepenultimate segments of the toxicognaths are reduced on the præaxial side of the appendage to the state of arthrodial integumental folds between the distal segment and the femur, which are firmly articulated together on its post-axial side. The tergal plate of these appendages always remains distinct and usually large, thus separating the cephalite from the tergum of the first leg-bearing somite. The pleural sclerites are well developed, and those of the last leg-bearing somite fuse with the coxa of the appendage, the second segment of which remains free. The anal and genital somites are incapable of retraction within the somite which bears the last pair of legs, and the gonopods typically persist in the male as small-jointed appendages, and in the female also as jointed or unjointed, often lobate sclerites.

Many families—Geophilidæ, Oryidæ, Gonibregmatidæ, etc.

Order 2.—Scolopendromorpha.

Chilopods departing from the primitive type and from the Geophilomorpha in having the number of leg-bearing somites fixed definitely to twenty-three or twenty-one, the reduction in number in the latter case being effected by the excalation of the two somites preceding that which bears the last pair of legs; by the evanescence of the tergal plate of the toxicognaths, which results in contact between the cephalite and the tergum of the first leg-bearing somite; in the ankylosis of the second and third segments of the legs of the last pair; in the incipient differentiation of the metameres into alternating major and minor leg-bearing somites, the regularity of the alternation, however, being interrupted at the seventh and eighth somites, both of which belong to the major category; in the power to withdraw the anal and genital somites out of harm's way into the last leg-bearing somite, in the total disappearance of the female gonopods, and the reduction of the segments of the male gonopods to one. With the shortening of the body and the lessening of the need of serpentine mobility, no prætergal sclerites are definitely cut off from the terga, though pairs of præsternal sclerites are developed. The eyes may be lost; when present they are invariably four in number. The segments of the antennæ never normally fall below seventeen nor above about thirty. On the other hand, the basal segments of the legs are feebly developed as in the Geophilomorpha, and the toxicognaths are modified and the pleural sclerite of the last leg-bearing somite enlarged and fused with the basal segment of the appendage as in the members of that order.

Several families—Scolopendriidæ, Newportiidæ, etc.

Order 3.—Craterostigmomorpha.

Chilopods derivable from a primitive form of Scolopendromorpha (which was furnished with twenty-one pedigerous somites, nineteen pairs of stigmata, complete penultimate and antepenultimate segments on the toxicognaths, distinct tergal plate for these appendages, and undivided tarsal segment on all but the last pair of legs, which had the first segment free), by the excalation of the sternal area and limbs of the third, sixth, ninth, eleventh, fourteenth, and seventeenth somites, thus reducing the number of legs to fifteen pairs; by the retention of six pairs of stigmata upon the somites bearing the third, fifth, eighth, tenth, twelfth, and fourteenth pairs of legs; by the enclosure of the anal and genital orifices in a bivalvular sclerite, representing probably the tergum of the anal somite, and by the complete fusion of the sternum and pleura of the fourteenth, and of the sternum, pleura, and tergum of the fifteenth leg-bearing somites.

One family—Craterostigmidæ (Craterostigmus).

Order 4.—Lithobiomorpha.

Chilopods derivable from the primitive form of Craterostigmomorpha by the excalation of the third, sixth, ninth, eleventh, and seventeenth tergal plates, which brings the terga and sterna into numerical conformity; by the differentiation of the terga into major and minor in the interests of flexibility; by an increase in the size of the basal segment of the legs, especially of the posterior pairs, and the segmentation of the tarsi of all the legs, or at least of the thirteenth and fourteenth pairs, to subserve rapidity of movement. In other respects the members of this order stand nearer the primitive type of the Chilopods than those hitherto considered. The tergum of the first pedigerous somite is relatively small in correlation with the weak muscularity of the toxicognaths, the basal segments of which are less strongly fused; the gonopods, present and jointed in both sexes in more archaic types, are always well developed in the females, and are supported upon a large ventral plate, which results from the fusion of their basal segments with the sternum of the genital somite; and lastly, in two families, the Henicopidæ and Cermatobiidæ, the stigmata are preserved upon the somite that bears the first pair of legs.

Three families—Lithobiidæ (Lithobius, etc.), Henicopidæ (Henicops, etc.), Cermatobiidæ (Cermatobius).

Sub-class Notostigma.

Chilopods descended from the Cermatobioid type of Lithobiomorpha by the replacement of the normal tracheal system by a series of median dorsal pulmonary sacs furnished with tubes dipping into the pericardial space, and opening each by a single stigma which results from the upward migration and coalescence of the normal pair of stigmata upon the first, third, fifth, eighth, tenth, twelfth, and fourteenth somites—a change in the method of respiration which is accompanied by the complete disappearance of the tergum of the seventh somite, either by excalation or by fusion with that of the eighth, and by the evanescence of all the minor terga except that of the fifteenth leg-bearing somite. Further specialisation is attested by the presence of a sense-organ on the gnathites of the second pair, by the polymeniscous eyes,[1] the duplication of the gonopods in the male,[2] and the extreme length and perfected annulation of the antennæ and of the distal segments of the legs, those of the fifteenth pair being clawless and simulating a couple of feelers both in form and function. In virtue probably of these extremely specialised features, mouth parts of a markedly primitive type have been preserved; the long and slender toxicognaths exhibiting only a partial axial rotation, long penultimate segments, and disunited and independently moveable coxæ, the palpognaths being also incompletely rotated, long and pediform, with the same number of segments as the primitive Chilopod limb, and projecting freely at the sides of the head; the præantennal area of the cephalite projects forwards and downwards in front of the bases of the antennæ, which remain widely separated as they are in the early embryonic stages in this

[1] I here provisionally adopt the view already suggested by others, that the faceted eye of Scutigera resulted from the packing together and mutual pressure of a number of monomeniscous eyes like those of Lithobius. But in view of the many primitive features appertaining to the head of Scutigera, the possibility must be borne in mind of the derivation of a set of monomeniscous eyes from one of a polymeniscous type, as has doubtless occurred in the case of the lateral eyes of Scorpio. Or, again, it may be that the large convex eye of Scutigera, with its many facets, corresponds as a whole, either in a derivative or originative sense, to the large single-lensed eye of Cermatobius, the genus which, beyond all possibility of doubt, is most nearly related to Scutigera in all other structural points.

[2] Possibly the additional gonopods represent the missing appendages of the anal somite.

class; and the second pair of gnathites are lengthened especially with regard to the second (femoral) segment to reach the mouth, which lies relatively far forwards.

Order Scutigeromorpha (characters as above).

One family—Scutigeridæ (Scutigera).

EXPLANATION OF PLATE 23,

Illustrating Mr. Pocock's paper, "A New and Annectant Type of Chilopod."

(The figures, depicting the structural features of Craterostigmus tasmanianus, were drawn by Mr. Pocock from the specimens of this centipede which are preserved in the Natural History Museum.)

Fig. 1.—Dorsal view of anterior extremity. *c.* Cephalite or head shield. *o.* Eye. *sf.* Frontal suture. *a.* Antenna. *bp.* "Basal plate" = tergum of toxicognath. *pl.* Pleural sclerite of toxicognath. *cx. p.* Coxal plate. *f.* Femur or third segment. *p.* Patella or fourth segment. *t.* Tibia or fifth segment. *cl.* claw or sixth segment of toxicognath. 1, 2, 3. Terga of first, second, and third somites.

Fig. 2.—Ventral view of toxicognaths, showing the præcoxal processes of the coxal plate (*cx. p.*), the second segment or trochanter (*tr.*), which is fused with the third segment or femur (*f.*), the præaxial teeth of the latter, and the completeness of the fourth and fifth segments (*p.*, *t.*) on the post-axial side of the appendage.

Fig. 3.—Lateral view of head and anterior extremity of body. Lettering of head and toxicognath as in Fig. 1. 1—7. Terga of anterior seven somites, numbers 3 and 6 being without sternal representatives. 1′—5′. Sterna of anterior five leg-bearing somites. *s.* Stigmatic, and *ms.*, metastigmatic sclerite. *pl. m.* Membrane of pleural area. *cx.* Coxa or basal segment of leg. *pcx.* præcoxal sclerite. *ps.* præsternal sclerite.

Fig. 4.—Lateral view of posterior extremity of body. 15—21. Terga of fifteenth to twenty-first somites. 10′—15′. Sterna of tenth to fifteenth leg-bearing somites. The rest of the lettering as in Fig. 3.

Fig. 5.—Dorsal view of last leg-bearing somite with ano-genital capsule (*ag.*) projecting from its posterior extremity. *t.* Tergal area of somite. 1 and 3. First and base of third segment of leg of fifteenth pair.

Fig. 6.—Ventral view of last leg-bearing somite and of ano-genital capsule (*ag.*). 1—3. First, second, and base of third segment of leg of fourteenth pair. 1′, 3′. First and base of third segment of leg of fifteenth pair. *s.* Sternal area of last leg-bearing somite. *ps.* Fused præsternal element.

Fig. 7.—Lateral view of the ano-genital capsule (*ag.*) and of the posterior half of the last leg-bearing somite. *lat.* Lateral area of this somite. 1. Basal segment of the leg.

Fig. 8.—Ventral view of cephalite or head plate. *a.* Basal segment of antenna. *sf.* subfrontal or retroverted præantennal area with labral sclerites.

Fig. 9.—Labrum. *t.* Teeth. *m.* Membranous lateral portion of excision.

Fig. 10.—Lower or posterior aspect of mandible or gnathite of first pair. *f.* Fringe of hairs at its distal extremity.

Fig. 11.—Upper or anterior aspect of the same. *f.* Fringe of hairs. *t.* Pectiniform teeth. *l.* Membranous lobe.

Fig. 12.—Distal extremity of the last still more enlarged, showing the series of nine pectiniform teeth arranged in groups of threes.

Fig. 13.—Inferior or posterior view of gnathites of the second pair (maxillæ). 1. Basal segment bearing the bisegmented ectocorm (1, 2) and the one-jointed ectocorm (*int.*).

Fig. 14.—Lower or posterior view of left palpognath. 1. Ectocoxite. 1′. Entocoxite. 2—5. Second to fifth segments, the second, or trochanter, fused with the third, or femur.

Fig. 14 *a.*—Distal segment of the same from its anterior or upper side, showing fringe of hair.

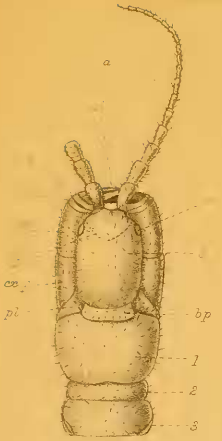
Fig. 15.—Lateral view of part of the third leg-bearing somite (fourth somite from the dorsal side). *t.* Tergum. *s.* Stigmatic sclerite with stigma. *ms.* metastigmatic sclerite. *pl.* Pleural membrane.

Fig. 16.—Leg of fourteenth pair. 1—6. Segments; 2 with inferior spike, 5 and 6 with spines.

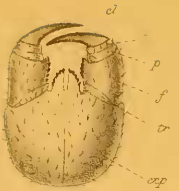
Fig. 17.—Basal portion of same. *lat.* Part of lateral portion of the fourteenth leg-bearing somite. 1. Basal segment or coxa of leg with subspherical excrescence or nodule (*n.*). 2. Second segment or trochanter with spike (*sp.*). 3. Base of third segment or femur.

Fig. 18.—Leg of the fifteenth pair. 1—7. First to seventh segments, the sixth and seventh representing the sixth of Fig. 16; 1 with inferior spike, 2 ankylosed to 3.

Fig. 19.—Basal portion of same. *lat.* Lateral area of part of fifteenth leg-bearing somite. 1. Basal segment or coxa with (*n.*) nodular prominence and (*sp.*) spike. 2. Remnant of the second segment or trochanter fused with the base of the third segment or femur (3).



1.



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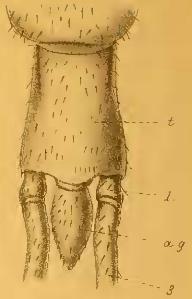

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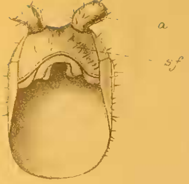

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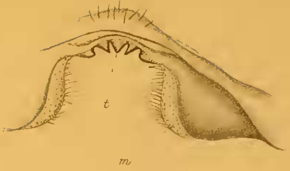

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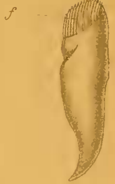

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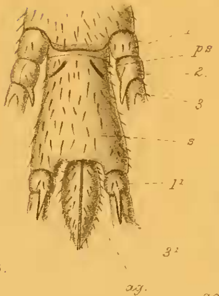

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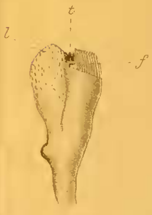

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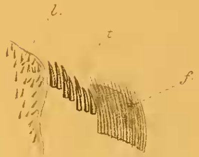

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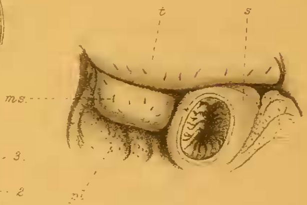

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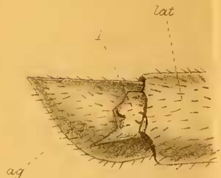

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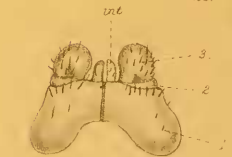

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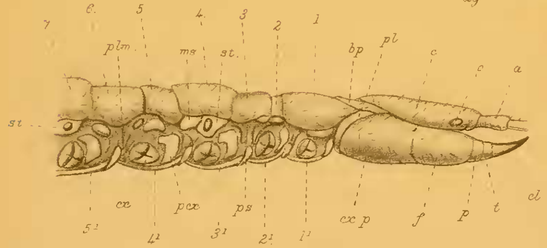

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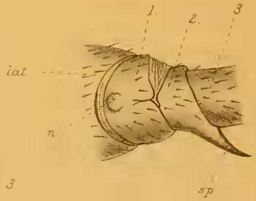

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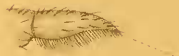

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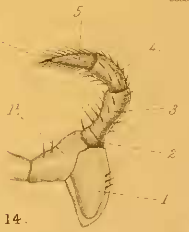

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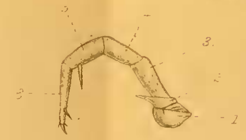

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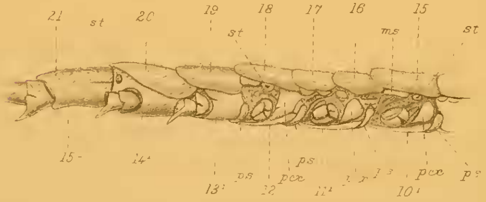

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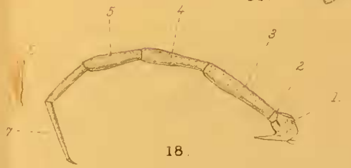

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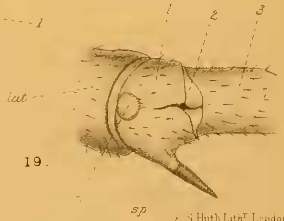

19.

G. S. Huth, Lith^r London